December 11, 1997 DRAFT

C&SF RESTUDY ALTERNATIVE EVALUATION TEAM REPORT ON THE PLAN FORMULATION ALTERNATIVE 1

Prepared by the C&SF Restudy Alternative Evaluation Team

Introduction

The Central and Southern Florida (C&SF) Project Restudy created an Alternative Evaluation Team (AET) for the purpose of evaluating the effects from a number of alternative plans, as a basis for developing the Comprehensive Plan for the C&SF Project. The objective of the AET evaluation process is to identify the plan (or plans) which best meets the regional restoration and sustainability goals set by the authorizing legislation for the C&SF Project, and the Conceptual Plan of the Governor's Commission for a Sustainable South Florida. The optimum components in a Comprehensive Plan are identified by means of an iterative evaluation process, whereby different combinations of these components are sequentially modeled and evaluated relative to a set of pre-determined performance measures. Components which substantially improve on base conditions, or which meet performance targets, are carried forward in the iterative modeling and evaluation process, while components which fail to perform well may be modified or rejected.

The AET is an ad hoc team, established by the Restudy for the specific purpose of evaluating a large number of alternative plans during a definitive planning process. The plan evaluation process is scheduled for September 1997 through April 1998. This report presents a summary of the conclusions of the second plan evaluation meeting of the AET, held 16-17 November 1997. At this meeting, the AET evaluated the Alternative 1 model simulation (summarized below). The core of this report is a set of evaluations conducted by ten subregional and issue subteams of the AET, relative to Alternative 1, and recommendations from these subteams and the full AET for improvements in performance required during subsequent plan simulations. This report also includes recommendations for improvements in the plan evaluation process, for incorporation in future evaluation cycles.

Methods

The AET is a multi-agency, multi-disciplinary team, consisting of about 30 members. The AET is divided into ten subregional and issue subteams, each with a chair or co-chairs (Kissimmee/Lake Okeechobee, Lake Okeechobee Service Area, Lower East Coast, Northern / Central Everglades, Southern Everglades, Estuaries and Bays, Big Cypress, Total Systems, ATLSS – Threatened and Endangered / Keystone Species, and Water Quality). During each evaluation cycle, each subteam has the lead responsibility for collecting all evaluations submitted to the AET from any non-AET source, which are applicable to the subregion and issues being

addressed by that team; additionally, each subteam performs its own evaluations. The subteams synthesize all evaluations into subteam reports to the full AET during each evaluation cycle.

Plan evaluations conducted by the subteams and the full AET are based on, (1) a set of pre-determined, hydrological performance measures, and (2) output from landscape-scale, ecological and water quality models. Each performance measure identifies specific hydrological targets, based on ecological, water supply, flood control and water quality objectives established for the C&SF Restudy. These hydrological targets have been defined in large part through the development of a suite of conceptual ecological models for the south Florida wetland landscapes, the draft Lower East Coast Regional Water Supply Plan, and the Lake Okeechobee Regulation Schedule Study. Performance measures may be added or deleted from the set used by the AET, based on recommendations from the subteams and approval by the full AET. Each alternative plan is evaluated based on the success of that plan in meeting the targets established by the performance measures. The hydrological performance of each plan is reported on the public web site during each evaluation cycle.

In addition to the performance measures, the AET may use output from three landscape scale models, the Across Trophic Level System Simulation model (ATLSS), the Everglades Landscape Model (ELM), and the Everglades Water Quality Model (EWQM). These models will be used to compare effects from alternative plans against either the current base (1995) or future "without project" base (2050). Summaries of output from these models, as it becomes available to the AET, will be reported in the AET evaluation reports.

Evaluations submitted by a subteam to the full AET, whether originating from the subteam or from an outside evaluator, are framed within the context of one or more performance measures. The full AET, during its meeting, synthesizes the subteam evaluations into a set of summary, "highlights" statements. These highlights statements are intended to describe the major strengths and weaknesses of the plan under current review, relative to the targets set by the performance measures. The highlights statements are provided to the Alternative Development Team (ADT) as a basis for designing the next alternative plan.

In addition to the brief, highlights report, the AET prepares a written report of each evaluation cycle. The written reports include short narrative summaries from each subteam, a list of the performance measures used by the subteams during that evaluation cycle, and recommendations for future plans and to the evaluation process.

Evaluation of Alternative 1

Plan Components

The following components are those which were included in the Alternative 1 hydrologic simulation by the South Florida Water Management Model (SFWMM). A more detailed description of the alternative can be found on the Restudy web site (www.restudy.org), Comprehensive Plan Evaluation, Alternatives Description / Evaluation.

Component A. A Storage Reservoir (20,000 acres at 10' maximum depth) north of Lake Okeechobee.

Component B. A Storage Reservoir (5,000 acres at 4' maximum depth) in the St. Lucie basin.

Component C. Environmental Water Supply Deliveries to the St. Lucie Estuary (operational change only).

Component D. A Storage Reservoir (20,000 acres at 8' maximum depth) in the Caloosahatchee basin.

Component E. Environmental Water Supply Deliveries to the Caloosahatchee Estuary (operational change only).

Component F. Current Lake Okeechobee Regulation Schedule (with the exception of regulatory releases to the St. Lucie Estuary).

Component G. A Storage Reservoir (40,000 acres at 6' maximum depth) in the Everglades Agricultural Area.

Component H. Everglades Rain-Driven Operations (Draft Lower East Coast Regional Water Supply Plan Alternative 5 Operational Rules for deliveries to the Water Conservation Areas and Everglades National Park).

Component I. Improved Conveyance between Water Conservation Area 3B and Everglades National Park (two additional S-355 structures).

Component J. Plug L-67A Borrow Canal (between S-151 and Modified Water Delivery structures S-345s).

Component K. Water Preserve Areas / L-8 Project Phase II in northern Palm Beach County.

Component L. Change Coastal Wellfields Operations (eastern Palm Beach and northeastern Broward counties).

Component M. Water Preserve Areas / Site 1 (1,660 acre at 6' maximum depth) in western Palm Beach County.

Component N. Water Conservation Area 2B Levee Seepage Management in Broward County.

Component O. Water Conservation Area 3A and 3B Levee Seepage Management in Broward County.

Component P. Water Preserve Areas / North New River Diversion Canal and Treatment Facility (1,600 acres at 4' maximum depth north of C-11) in Broward County.

Component Q. Water Preserve Areas / Western C-11 Diversion Canal (to Central Lake Belt Storage) in Broward County.

Component R. Water Preserve Areas / C-9 Impoundment (2,500 acres at 4' maximum depth) in Broward County.

Component S. Central Lake Belt In-ground Storage Reservoir (~10,000 acres) in Dade County.

Component T. C-4 Structure in Dade County.

Component U. Water Preserve Areas / Bird Drive Impoundment (2,877 acre at 4' maximum depth) in Dade County.

Component V. L-31N Levee Improvements for Seepage Management in Dade County.

Alternative 1 Highlights

The following highlights represent the major strengths and weaknesses of Alternative 1, as evaluated by the AET:

A. Total System Subregion
Please see the subteam's narrative report.

B. Kissimmee / Lake Okeechobee

Problem: Harmful prolonged low lake stages (<11 ft for 400 days) not observed in the 1995 Base.
Rationale: Harmful prolonged low stages were observed in the 2050 Base. Alternative 1did not fix this problem.
Recommendation: The subteam recommends that the ADT address this issue when formulating the next Alternative.

Problem: Too many extremely high (>17 ft) and low (<11 ft) events.
Rationale: The overall pattern of water level variations under Alternative 1 did not resemble the restoration goal, wherein lake levels generally should vary between 12 and 15 ft NGVD. In particular, the lake experienced too many extreme high (>17 ft) and low (<11 ft) events.

Note: Alternative 1 improved the median duration of high stage events compared to 1995 and 2050 Base conditions, but continued to include one prolonged (> 15 ft for 900 d) event. This does not appear to be a problem to be "fixed" by the ADT since it reflected a natural event -- an atypical high rainfall period.

C. Lake Okeechobee Service Area

Problem: To meet the 1 in 10 year level of certainty water supply (as indicated by supply side management for agriculture and water shortages for urban).
Rationale: In Alternative 1, water use restrictions in the Lake Okeechobee Service Area occur with a frequency of between 1 in 5 and 1 in 3 years (better than 2050 Base but about the same as the Starting Point). In several years, water available for delivery is severely limited by extremely low levels in Lake Okeechobee. Overall percentage of demands not met is substantial. The EAA situation is almost the same as with the Starting Point and Caloosahatchee agriculture is worse than the Starting Point.

D. Lower East Coast

Water Supply:
Problem: Water shortages triggered by local wells in the North Palm Beach Service Area are approximately as frequent and severe for Alternative 1 as the Starting Point.
Rationale: In the North Palm Beach Service Area, the Water Catchment Area is drying out due to a lack of deliveries from the regional system. This includes the Gardens which is hardest hit, experiencing eight Phase 1 shortages, eight Phase 2 shortages and one Phase 4 shortage. Note that compared to the 1995 Base, fewer shortages occur in this service area, however, the Gardens experiences the vast majority. The purpose of Component K was not realized in Northern Palm Beach County. The Water Catchment Area is drying out severely. Also, there are concerns over the quality of water discharged to or through the M-Canal as part of the L-8 Project.
Recommendations: The Water Catchment Area needs to be connected to the regional system. There may be too much water being discharged to tide without much benefit or perhaps too much to the North Fork of the Loxahatchee. Future alternatives should take into account the need to store additional surface water.

Note: Water shortages triggered by local wells for service area one (SA1) are less frequent than the Starting Point. The notable improvement is Lake Worth which drops from 32 Phase 1 shortages to just five in Alternative 1. In addition, Boca Raton and Highland never experience any shortages in Alternative 1. The frequency for shortages in Alternative 1 mimics the 1995 Base.

Problem: In service area 2 (SA2), the frequency of shortages in Alternative 1 are even greater than the 1995 Base. This is an unacceptable number of shortages.
Rationale: In SA2, the same problem triggers in the Starting Point occur again in Alternative 1. North Lauderdale experiences 11 Phase 1 shortages, FTL Airport experiences 34, and Hollywood sees 77 Phase 1, 24 Phase 2, and one Phase 3. The seepage barrier restricting surface water flows cannot be compensated adequately with surface water canal deliveries to recharge the aquifer. In addition, sending surface water flows and seepage south may be impacting the Hollywood and FTL Airport triggers.

Recommendation: For SA2, perhaps more of Hollywood's demands could be moved west or perhaps decreased through conservation and greater utilization of reuse. Or additional water could be "stored" in the secondary canals in the C-11 Basin creating more head to move water east. Surface water levels could be increased up to the highest level that does not compromise flood protection. Or modify the operation of the water preserve area. A recharge canal could be constructed between the C-14 and C-13 to bring water to the North Lauderdale well field area. Another potential source for water may be the Acme Basin B. This water could be stored, treated, and released to meet water supply needs.

Problem: In service area 3 (SA3), there are many improvements in Alternative 1 over the Starting Point. The high number of Phase 1 and Phase 2 shortages in the Starting Point diminish for all trigger wells. The exception is Homestead which experiences 13 Phase 1 shortages in Alternative 1. The shortages in Alternative 1 are similar to the 1995 Base with no Phase 2 restrictions outside of Homestead.
Rationale: In SA3, the seepage barrier could be causing the problems in Homestead.
Recommendation: This could be compensated for by sending more water down L-31N, C-111, C-1, C-100, C-102 and C-103 in the dry season.

Problem: There is no reduction in the number of Lake Okeechobee shortages for Alternative 1 over the Starting Point or 1995 Base for all of the LECSA. The frequency of shortages triggered by Lake Okeechobee ranges between 11 and 17 for Alternative 1.
Rationale: There may not be enough water in Lake Okeechobee in the beginning of the dry season, pushing the LECSA into water cutbacks.
Recommendation: Modify the regulation schedule or propose alternatives that will make more water available from Lake Okeechobee in order to meet demands and avoid shortage triggers. Perhaps ASR wells combined with a modified regulation schedule could be considered.

Water Deliveries:
Problem: For SA1, a greater volume of deliveries from the regional system in the drought years occur in Alternative 1, an increase from 97,000 acre-feet in the 1995 Base to 192,000 acre-feet Alternative 1. The increase is reflected in the average annual deliveries.
Rationale: The dramatic increase is due either to filling STA 1 with water for storage, L-8 not working quite right, and / or the operation of the S-316 control structure is problematic.

Problem: For SA2, additional water is required from Lake Okeechobee and the WCA during the drought years. The increase in deliveries from the regional system is from 26,000 acre-feet in the 1995 Base to 82,000 acre-feet in Alternative 1.
Rationale: The increase in deliveries is probably to overcome the effects of the seepage barrier. Canal levels in the C-11 and C-9 are affected as well.

Problem: Deliveries from Lake Okeechobee to SA3 increase in drought years by about 50%. It should also be noted that the average annual deliveries to SA3 decline significantly in Alternative 1 (68,000 ac-ft) when compared to the 1995 Base (127,000 ac-ft), 2050 Base (121,000 ac-ft) and Starting Point (140,000 ac-ft).
Rationale: Deliveries from the WCA to SA3 decline since the "bathtub" is relied upon. This may be reflected in the decreased flows to Biscayne Bay and failure to meet salt-water intrusion

criteria for canals. But greater dependence on Lake Okeechobee is experienced during drought years making the area more vulnerable.
Recommendation: May need to modify seepage barriers and/or increase surface water flows to meet canal salt-water intrusion criteria and estuarine needs.

Canal Levels:
Note: The canal stages meet salt-water intrusion criteria for the C-51, C-16, C-15 and Hillsboro canals.
Rationale: Not sure what changed in Alternative 1 to enable meeting salt-water intrusion criteria for these northern canals.

Problem: The canal levels in Alternative 1 do not meet the salt water intrusion criteria for the following:

C-2 @ S-22 - improves over the 1995 and 2050 Base.
C-9 @ S-29 - improves over the Starting Point, 1995 Base and 2050 Base.
C-14 @ S-37B - improves over the Starting Point, not much better than the 2050 Base and fails to meet criteria more frequently than 1995 Base.
C-4 @ S-25B - fails more often than in the 2050 Base.
C-6 @ S-26 - performs better than the 1995 and 2050 Base, but fails 25% of the time.

Rationale: There was a significant lowering of many of the canal levels from the 1995 Base to just above the salt-water intrusion level. For example the C-9 is lower than the 1995 and 2050 Base approximately 65% of the time but is held on to longer, which enables meeting the salt-water intrusion criteria 87% of the time. By holding levels closer to the salt-water intrusion, less water is available for recharge, but also less water may be lost to tide as evidenced by the reduction in discharges from structures in the water budgets.
Recommendation: Increase surface water deliveries and/or hold water higher within the primary and secondary canals.

Flood Protection:
Problem: In Dade County, the seepage barrier is not very helpful for flood protection as shown in cell R19/C27. The stage-hydrograph curves indicate that stages are slightly higher for Alternative 1 compared to the 1995 Base, during both the wet and dry seasons.

Problem: Further south, flood protection may be adequate as indicated by the stage hydrographs in cells R17/C27 which are lower in Alternative 1 than in the 1995 Base. These lower ground levels occur primarily in the wet season.
Rationale: The improvements for flood protection may not be attributable to the seepage barrier since the results for the Starting Point, 2050 Base, and Alternative 1 are similar.

Problem: The performance measures for cells R15/C26 and R13/C25 show higher stages for Alternative 1 than for the 1995 Base about 90% of the time, especially during the wet season. The stage is within 18" of the ground surface for about a third of the time, especially in the wet season.
Recommendation: The operation of the C-111 and L-31 may need to be altered to enable flows in the dry season to meet water supply needs and reduced flows in the wet season for flood protection, or alter the seepage barrier.

E. Northern / Central Everglades (WCAs, Holey Land, Rotenberger)

Loxahatchee National Wildlife Refuge (WCA-1):
Problem: The 2050 Base, Starting Point, and Alternative 1 all have lower depths than the 1995 Base. In the north, Alternative 1 has a shorter hydroperiod than NSM; its annual recession begins later than NSM; and depths exceed NSM throughout the year. In the south, Alternative 1 is approximately 2 ft deeper than NSM year-round.
Recommendation: The ADT should determine what components are needed to provide for an evaluation of the possible benefits of rainfall-based operational rules in WCA-1, and for reducing the north-south impoundment effects for purposes of providing more NSM-like conditions throughout.

WCA-2A:
Problem: The 2050 Base, Alternative 1, and Starting Point all are similar in performance; however, wet season highs are too deep in wet years in the south and dry season lows in dry years are too low in the north. Year-to-year fluctuations and within-year depth reversals are larger than NSM. All three scenarios overshoot NSM wet season depths by 0.5 ft and may further damage already-damaged tree islands. Alternative 1 and the Starting Point have shortened hydroperiods during dry years in Northern WCA-2A (90% Alternative 1; 88% Starting Point; 94% NSM).
Recommendation: Alternative 2 should include changes that reduce the magnitude of water depth reversals, the amplitude of high/low fluctuations, and better approximate NSM depth patterns.

WCA-2B:
Problem: Alternative 1 and the Starting Point are too deep for too long. Neither alternative is acceptable as a hydropattern for a reasonably healthy Everglades marsh. There are potential adverse impacts for snail kite foraging and nesting in WCA-2B.
Recommendation: Alternative 2 needs to reduce water depths substantially, with an interim aim of –1.5 ft relative to Alternative 1. Move the water south if possible.

WCA-3A (north of Alligator Alley):
Recommendation: None at present.
Note: There is no difference between Alternative 1, the Starting Point and 2050 Base; all are better than 1995 Base. Alternative 1 performs worst during extreme wet years. In northeast WCA-3A, the 2050 Base, Starting Point, and Alternative 1 are about 0.4 ft. deeper than NSM during the dry season.

East-Central WCA-3A (south of Alligator Alley and east of the Miami Canal):
Problem: The water is too deep, for too long. Alternative 1 is worse than the Starting Point and 2050 Base.
Recommendation: Reduce surface water ponding in this area and redirect flows to the south.

West-Central WCA-3A (south of Alligator Alley, Indicator Regions 17 & 18):
Recommendation: Alternative 2 should avoid further drying of this area.
Note: Alternative 1 is close to NSM, with slight improvement over the Starting Point and 2050 Base, but Alternative 1, Starting Point, and 2050 Base water levels are significantly lower than the 1995 Base in region 17 and there are more frequent dry-outs. This area represents one of last

unimpacted areas of the WCAs that exists outside of ENP, so significant lowering of depths in this area should be avoided.

WCA-3A South:
Recommendation: None. However, DOI recommended increased gapping of the L67A and L67C levees to convey water from this area to WCA-3B.
Note: Alternative 1 appears to be slightly wetter than the Starting Point and 2050 Base, and continues to pond west of L-67A.

WCA-3B:
Problem: Under Alternative 1 water depths are too deep for too long in northwest WCA-3B. Water depths generally meet the NSM targets in southeast WCA-3B. The L-67A canal plug (Component J) does not appear to have reduced flows into WCA-3B. There appears to be plenty of water in WCA-3B, but it is not getting conveyed to ENP.
Recommendation: Alternative 2 needs to increase conveyance of WCA-3B water to ENP.

Pennsuco Wetlands:
Problem: Alternative 1, like the Starting Point, tended to both overshoot and undershoot NSM targets.
Recommendation: Need to reduce water depths in Pennsuco wetlands; move closer to NSM target.

Holey Land Wildlife Management Area:
Problem: Under the 2050 Base, the Holey Land is approx. 0.4-0.6 ft too deep year round, with long periods (several years) of inundation and interannual fluctuations greater than the NSM target. Neither Alternative 1 nor the Starting Point ameliorates these problems. Risk of further cattail expansion with added water is a concern.
Recommendation: Alternative 2 should bring depths down by approximately 0.5 ft year round, while minimizing the frequency and duration of depths greater than 1.5 ft, and less than -1.0 ft.
Recommendation: Alternative 2 should consider modeling the new Holey Land regulation schedule under development in order to compare the results to rainfall-based operations.

Rotenberger Wildlife Management Area:
Problem: The 2050 Base, Alternative 1 and Starting Point moderately overshoot NSM. Similar issues to those in the Holey Land face the Rotenberger regarding cattail risk and the need to avoid extreme dry-outs.
Recommendation: Alternative 2 should aim to reduce depths by approximately 0.3 ft year round.

F. Southern Everglades (Everglades National Park, Model Lands)

Northeast Shark Slough:
Problem: Alternative 1 is worse than the Starting Point in frequency of drydowns. Alternative 1 resulted in water depths that were lower overall than NSM.
Recommendation: Incorporate seepage control strategies, such as buffer lands, sufficient to restore NSM-like conditions.

Problem: The number of drydowns in NESS is six times greater than predicted by NSM.
Rationale: This frequency of drydowns in the heart of the historic Shark Slough will continue to demonstrably lower standing crops and alter community composition of fishes and aquatic invertebrates and loss of peat soils. *Melaleuca* expansion will continue to progress westward into the slough because of overdrainage resulting in shorter hydroperiods.
Recommendation: Reduce the number of drydowns.

Shark Slough:
Problem: Alternative 1 consistently failed to meet NSM. Hydroperiods and flows predicted by Alternative 1 were lower than NSM. In dry years, Alternative 1 indicated that Shark Slough dried for as much as three months longer than under NSM. This would be devastating to aquatic communities.
Rationale: In a dry year NSM predicts a persistent pool aligned along the main stem of the historic Shark Slough in accordance with natural topographic contours. The pattern of dry season pooling evident in Alternative 1 is similar to that seen today with dry season ponding occurring in WCA-3 and with values lower than NSM south of Tamiami Trail. The cessation of sufficient overland flow into Shark Slough has resulted in the reduction or elimination of persistent pooling, as well as increased frequency of drydowns, affecting survival and productivity of aquatic organisms.
Recommendation: Explore using the lowest management intensive strategy to establish rainfall-based flows. These flows must extend from the upper to the lower reaches of the Everglades catchment area in sufficient volume to maintain dry season pool formations that persist within the downstream reaches of the system, with hydropatterns similar to those predicted by NSM.

Rocky Glades / Eastern Marl Prairies:
Problem: Although Alternative 1 provided some improvement over the various base alternatives, it fell significantly short of restoration targets when compared with NSM.
Rationale: NSM predicted relatively longer hydroperiods than the 1995 Base and both the Starting Point and Alternative 1. Restoration of more natural hydropatterns in this area will result in a suite of ecological benefits for aquatic communities and endangered species.
Recommendation: Restoration needs to provide longer continuous hydroperiods, greater ponding depths, and more frequent occurrence of multi-year continuous inundation.

Taylor Slough:
Note: The output provided for Taylor Slough was not adequate to make an assessment of the alternative. Model runs for more stations within Taylor Slough are needed.

C-111 Basin:
Problem: Alternative 1 shows that there are 1.5 times the number of drydown events in Indicator Region 4 as predicted by NSM.
Rationale: The increased frequency of drydowns substantially negatively affects the survival and productivity of aquatic organisms, and associated ecological processes.
Recommendation: Restoration strategies for the C-111 basin must reduce the frequency of drydown events. Sheetflow must be reestablished in the basin, including filling in canals,

ditches, and culvert pools to reduce colonization opportunities by exotic organisms, and to eliminate artificially large, deep-water habitats that result in changes in species composition and energy flow in the adjacent wetlands.

Model Lands:
Problem: All alternatives, including Alternative 1, demonstrate that the Model Lands remain hydrologically isolated, producing conditions that do not approximate NSM conditions.
Rationale: The basin is closed and ecologically degraded, lacking connection with adjacent wetlands to the west. The significant reduction in spatial extent of the historic natural system requires that efforts be make to restore these wetlands.
Recommendation: Explore strategies to improve the timing and distribution of water deliveries to the Model Lands.

G. Estuaries and Bays

Caloosahatchee Estuary:
Problem: To meet minimum flow at Caloosahatchee (300cfs).
Rationale: The number of times low flow discharges were not met decreased with the Alternative 1, as compared to the Starting Point and 2050 Base, but the target still has not been reached. A base flow of 300 cfs is needed to maintain appropriate salinities.
Recommendation: The subteam recommends that a mean monthly baseflow of 300 cfs be provided through S-79 to help meet the desirable salinity distributions in the Caloosahatchee Estuary.

Problem: No regulatory releases from Lake Okeechobee are desired.
Rationale: There was a small increase in regulatory releases to the Caloosahatchee Estuary. However, Alternative 1 decreased the number of months that the total monthly inflow from C-43 basin exceeded 2800 cfs as compared to 2050 Base, 1995 Base, and the Starting Point.
Recommendations: The subteam recommends that all regulatory releases from Lake Okeechobee be eliminated to help meet the desirable salinity distributions in the Caloosahatchee Estuary.

Recommendation: The Lower West Coast Planning Division of the SFWMD could provide an operational rule for a storage facility in the C-43 basin. The operational rule was developed using the Optimization model and the period of record rainfall.

Recommendation: The stage hydrograph in C-43 basin indicates that there may be opportunities to capture more excess runoff within the basin if the reservoir could accommodate additional storage.

St. Lucie Estuary:
Problem: To meet minimum flow to St. Lucie Estuary (350cfs). A base flow of 350 cfs is needed to maintain appropriate salinities.
Rationale: The number of average low flows (<350 cfs) were greatly reduced with Alternative 1 as compared to the 2050 Base, 1995 Base, and Starting Point.

Problem: No regulatory releases from Lake Okeechobee are desired.
Rationale: Regulatory releases have been eliminated and the number of high discharge events were decreased with Alternative 1, as compared to the 2050 Base and Starting Point. Overall, Alternative 1 displayed great improvements for the St. Lucie Estuary, but the targets have yet to be attained.
Recommendation: Continue moving toward meeting targets for low (<350cfs) and high (>1600cfs) flows of 50 and 13 months, respectively. Increase storage capacity of reservoir in C-44 basin and capture additional runoff to reduce the number of times high flows exceed criteria and minimum flows are not met.

Lake Worth Lagoon:
Problem: To meet minimum flow to the Lake Worth Lagoon (150 cfs).
Rationale: The C-51 performance criteria indicated that Alternative 1 did not change the amount of water to Lake Worth Lagoon as compared to the 2050 Base and Starting Point.
Recommendation: Based upon previous studies done on the Lake Worth Lagoon, a mean monthly freshwater baseflow of roughly 150 cfs is needed to maintain estuarine conditions in the dry season.

Note: The target of no regulatory releases has not been met.

Biscayne Bay:
Problem: The Starting Point reduces wet season flows by > 40% and dry season flows by > 50%.
Rationale: Alternative 1 provides for slightly more freshwater input into southern and central Biscayne Bay and more to northern Biscayne Bay than the Starting Point. However, Alternative 1 still provides much less water than either the 2050 Base or 1995 Base. In this regard, Alternative 1 has not moved Biscayne Bay toward the goal of more estuarine conditions.
Recommendation: Improve estuarine conditions by increasing water flow to Biscayne Bay.

Florida Bay:
Problem: Undesirable high salinity events; too few desirable low salinity events.
Rationale: Alternative 1 increased the frequency of undesirable high salinity events and decreased the frequency of desirable low salinity events in all coastal basins of Florida Bay, as simulated by salinity/P33 stage regressions, and in the multiple station average for Florida Bay, as simulated by the Florida Bay Ecosystem Model. Both Alternative 1 and the Starting Point were improvements compared to the 2050 Base and 1995 Base. The Starting Point accomplished approximately half the progress that is required to accomplish the salinity objectives for the coastal basins. Alternative 1 was a step backwards.
Recommendation: In order to decrease the frequency that coastal basin salinity exceeds the upper levels identified for each basin, raise P33 stages above 6.3 ft MSL during approximately 79 months of the period of record when NSM 4.5 exceeds that stage but Alternative 1 does not. These events occurred in January-May during 19 years; in June-October during 15 years; and in November-December during 8 years of the 31 year period of record.

Recommendation: In order to increase the frequency that coastal basin salinity drops below the lower levels identified for each basin, raise P33 stages to 7.3 ft. MSL during approximately 48 months of the period of record when NSM 4.5 exceeds that stage but Alternative 1 does not. These events occurred in January-February during 2 years; in July-October during 10 years; and in November-December during 4 years of the 31 year period of record.

H. Big Cypress National Preserve

Problem: There are some reductions from NSM water levels along the eastern side of the Big Cypress.
Rationale: L-28 could be causing the changes in water levels in the eastern portion of the Big Cypress. Given the ponding that currently exists in the lower end of WCA-3A, removal of L-28 would probably increase water levels in the adjacent Big Cypress more than would be considered desirable. However, changes scheduled to be made by 2050, suggest that this ponding will no longer exist at that time. Thus, removal or at least opening portions of the L-28 at that time could provide more natural water flows through the Big Cypress.
Recommendation: Eliminate or create openings in the L-28 to allow unimpeded exchange.

Problem: There appear to be inconsistencies with available ecological information as regards the hydroperiods in the westernmost two (three?) columns of cells in the Big Cypress that are generated by the models, particularly the NSM.
Rationale: The current and historic plant communities in this area could not exist with the indicated hydroperiods.
Recommendation: Try to determine what is causing the problem.

I. Water Quality

Problem: Reservoirs/storage areas should be operated to optimally reduce phosphorus loads.
Recommendation: Reservoirs/storage areas should be operated to maintain minimum depths of 2.0 ft and minimum hydraulic retention time of 14 days.

Problem: Phosphorus loading into Lake Okeechobee is too high.
Recommendation: Storage reservoir should be located in Taylor Creek/Nubbin Slough basin.

AET Subteam Narratives

A. Total System Subregion

Performance Based Comments:

Please see Attachment 1 to this report for the following information in table form. Alternative 1 showed improvements in about 10,000 acres more than the Starting Point, however

the tradeoff was an increase in the number of acres with both shortened and lengthened hydroperiods.

	STRPT	ALT 1
Acres with improved Hydroperiods	340,480	350,720
Acres w/shortened hydroperiods	61,440	102,400
Acres w/ lengthened hydroperiods	87,040	107,520

In WCA-3B improvements in the Starting Point were mostly in the more favorable 30-90 day category, but in Alternative 1, they were mostly in the less favorable 7-30 day category.

In the Pennsuco Wetlands, improvements were longer with Alternative 1 (mostly in the 30-90 day category) than with the Starting Point (mostly 7-30 day category). However, for the acres experiencing wetter conditions than NSM predicted, they, too were wetter (in the >30 day category) for Alternative 1 than for the Starting Point (<=30 days).

Alternative 1 was no better than the Starting Point and was much worse for WCA-2B (-18%), however, it mirrored the Starting Point in some benefits to WCA-2B (+18%), 3B (22%), and ENP (16%) over the 2050 Base. Alternative 1 was worse than the Starting Point everywhere except WCA-2B (+9%) and Pennsuco (+25%). It was either worse or no better than 2050 everywhere except for Pennsuco (+25%) and Everglades National Park (17%).

Performance Measures and Indicators Used:

1. Hydroperiod Improvement Relative to Future Base

2. % Cells with Hydroperiod Matches with NSM.

3. Ponding Depths, % Cells Matching NSM.

4. Hydroperiod Distribution

B. Kissimmee / Lake Okeechobee Subregion

Performance-Based Comments:

There were no performance measures evaluated for the Kissimmee region.

Surface water inputs to the lake were reduced by 7,000 ac ft y^{-1} in Alternative 1 relative to the 2050 Base condition, a 0.1% change in total inflow volume. Surface water outflows from the lake were increased by 29,000 ac ft y^{-1} (2%). Evapotranspiration losses from the lake were increased by 22,000 ac ft y^{-1} (1%). These are very slight changes that certainly fall within the error of the estimates.

The stage duration curves indicate that Alternative 1 achieved an overall greater water level regime for the lake than the 2050 Base condition, but lake levels still were lower than under the

1995 Base condition. The difference between curves was most pronounced at lower water levels. It is noteworthy that the stage duration curve for Alternative 1 is nearly identical to that for the Starting Point. Likewise, box-and-whisker plots indicate that median, maximum, and minimum water levels under Alternative 1 were nearly identical to those for the Starting Point, and quite similar to those under the 1995 and 2050 Base conditions. All cases gave considerably more variation in lake levels (both at the high and low ends) than is considered desirable to maintain a healthy ecosystem.

The daily stage hydrograph indicates that under Alternative 1, the lake fell below 11 ft NGVD on ten occasions during the 31-year period of record, as compared to 9 occasions under the Starting Point scenario, and 12 and 8 times under 2050 and 1995 Base conditions. When the lake falls below 11 ft NGVD, the littoral community experiences significant harm from habitat loss and increased expansion of exotic plants. Both the Starting Point and Alternative 1 helped prevent the additional occurrences of those conditions that developed under the 2050 Base, but still fell short of the goal of having no such events.

The daily stage hydrograph indicates that under Alternative 1, the lake rose above 17 ft NGVD on five occasions. This is the same number observed under the 2050 Base and Starting Point conditions. When lake levels are >17 ft NGVD the littoral community experiences significant harm due to wave damage, nutrient inputs, and turbid water. Under the 1995 Base conditions, six high water events occurred. None of the scenarios achieved the goal of no such events.

Box-and-whisker plots showing the similarity in duration of stage events >15 ft NGVD indicate that Alternative 1 produced a median duration for such events that was considerably lower than under 2050 Base conditions. This is a positive result, because prolonged periods of moderately high lake levels harm the ecosystem due to losses of benthic plant communities, and greater lake-wide circulation of turbid, phosphorus-rich water. Under Alternative 1, there was a single >15 ft event lasting 900 days. This harmful event occurred due to a 1 in 300 year rain event in south Florida, and is not considered to be a problem that can be “fixed” by the Restudy.

Box-and-whisker plots showing the similarity in duration of stage events <12 ft NGVD indicate that Alternative 1 produced a median duration for such events that was considerably lower than under 2050 Base conditions. This also is a positive result, because prolonged periods of moderately low lake levels harm the ecosystem due to losses of wildlife habitat and increased rates of exotic plant expansion.

Box-and-whisker plots showing the similarity in duration of stage events <11 ft NGVD indicate that Alternative 1 gave a median duration for such events that was considerably lower than under 2050 Base conditions. This is another positive result, because extreme low lake levels cause significant harm to the ecosystem due to loss of nearly all littoral wildlife habitat, and more rapid expansion of exotic plants into marsh areas. A single <11 ft event lasting over 400 days continued to occur under Alternative 1 (and the Starting Point). It appeared to be due to greater water demands under the 2050 Base condition, since the duration under the 1995 Base was closer to 200 days. This is an undesired result that should be addressed under future Alternative development.

All scenarios gave similar scores for spring lake level recession. Additional statistical evaluations are needed to quantify how wading bird foraging and nesting correspond with the spring recession, or water level variations in general. Until this is done, this particular measure should be considered with caution.

Comments received by email included the following (abbreviated) text.

(1) FDEP: The number of undesirable stage events increased with this alternative...this conflicts with ecosystem goals for enhancing and sustaining the health of the lake's littoral zone.

(2) National Audubon Society: The starting point and Alternative 1 display little variation on the stage duration curves in respect to lake stages exceeding 15 ft, the lake elevation above which the entire littoral zone is flooded.

(3) SFWMD: Review of stage duration curves found no difference between the Starting Point and Alternative 1 with regard to average lake water depths of the percent of time water levels inundated the littoral zone. In fact both the Alternative 1 and Starting Point tracked each other almost identically throughout the 31 year period of record. Both Alternative 1, the Starting Point, and the 2050 Base met the District's proposed minimum water level criteria for the lake.

(4) FGFWFC: Although the Starting Point and Alternative 1 are expected to reduce the frequency of damaging low water conditions predicted for the 2050 Base, they predict no reduction in the frequency of low water conditions relative to the 1995 Base, and an increase in the frequency of damaging high water. Since the regulation schedule used in all four models, Run 25, is already expected to lead to too-frequent damaging high lake stages, the Starting Point and Alternative 1 overall predict worsened conditions for the lake ecosystem. Recommend that the ADT evaluate a regulation schedule that is designed to reduce the frequency and duration of undesirable high and low lake stages.

Performance Measures and Indicators Used:

Measures: box-whisker plots showing duration of > 15 ft lake stage events
box-whisker plots showing duration of < 12 ft lake stage events
box-whisker plots showing duration of < 11 ft lake stage events
daily hydrographs with spring recession windows

Indicators: lake inflow, outflow, and ET volumes
30 year daily hydrographs
stage-duration curves

Recommendations:

1. The 2050 Base condition resulted in harmful prolonged low stages (<11 ft for 400 days) not observed in the 1995 Base. Alternative 1 did not fix this problem. The Lake Okeechobee

subregion team recommends that the ADT address this issue when formulating the next Alternative.

2. Alternative 1 improved the median duration of high stage events compared to 1995 and 2050 Base conditions, but continued to include one prolonged (> 15 ft for 900 d) event. This does not appear to be a problem to be "fixed" by ADT since it reflected a natural event -- an atypical high rainfall period.

3. The overall pattern of water level variations under Alternative 1 did not resemble the restoration goal, wherein lake levels generally should vary between 12 and 15 ft NGVD. In particular, the lake experienced too many extreme high (>17 ft) and low (<11 ft) events.

C. Lake Okeechobee Service Area Subregion

Performance Based Comments:

Total EAA/LOSA irrigation demands and demands not met level of service do not meet Restudy goals. The State's water supply goal of meeting demands in a 1 in 10 year drought is not met by Alternative 1. Examination of the Lake Okeechobee daily stage hydrograph and the monthly supply-side-management reports show that the Lake Okeechobee Service Area is modeled as being under supply side management for a substantial portion of seven dry seasons. Supply side restrictions are in place in 17 of the 31 years modeled. Although the summary bar chart of "Total Demands Not Met" shows no difference for the EAA and an increase from 11% to 14% for the other LOSA areas, the annual results summaries show that extreme conditions occur more often. In several situations, lake levels were very low and little to no deliveries were made for four or more months in a row. Furthermore, during four additional years a large portion of the dry season was spent with the lake level walking the supply side management line. The frequency of water shortages is the same as the Starting Point, somewhere between 1 in 5 and 1 in 3. Cumulative Total Demands Not Met running around 13 % are high.

The situation in the Caloosahatchee agricultural basin has deteriorated as compared to the Starting Point (from 8.25 % to 12.86 % demands not met). Operation of the larger reservoir in the Caloosahatchee basin for environmental deliveries to the estuary seemed to be the reason the irrigation demands not met increased in Alternative 1. A similar situation is occurring in the St. Lucie basin, where water supply cutbacks increase from 15.16 % (in the 1995 Base) to 18.72 % in Alternative 1.

The threat of high water levels in Lake Okeechobee causing flooding in the Lake Okeechobee Service Area increased slightly in Alternative 1 compared to the Starting Point.

Performance Measures and Indicators Used:

1. Lake Okeechobee Daily Stage Hydrograph
2. Mean Annual EAA/LOSA Irrigation Demands and Demands not Met
3. Report – Monthly Supply Side Management Results.

4. Report – Cumulative Total Demand, Cut-back Volume, and Cutback Over Period of Simulation.
5. Number of Undesirable Lake Okeechobee Stage Events.
6. Peak Stage Differences (.25 ft. higher).
7. Flood Protection Criteria for Lake Okeechobee
8. Regional Water Budgets

Recommendations:

1. Either more stored water is needed or the reservoirs need to be operated in a manner a little more favorable to agricultural and urban water supply.

D. Lower East Coast Subregion

Performance Based Comments:

The Lower East Coast Service Area (LECSA) faired acceptably to below average for water supply, resource protection and flood protection. The Lower East Coast Service Area 2 was hardest hit with 122 water supply cutbacks, while two local trigger wells affected North Palm Beach and Service Area 3. The number of water supply cutbacks triggered by Lake Okeechobee levels remained fairly constant compared to the 1995 Base and the Starting Point. Protection of the Biscayne Aquifer from salt-water intrusion was hit and miss. The canals in the northern part of the service area faired well, while the canals further south experienced levels below their salt-water intrusion criteria between approximately 9 to 25 percent of the time. The LECSA was more dependent on Lake Okeechobee for water deliveries during drought years. There was no pattern in the increase or decrease in the deliveries from the WCAs to the service areas. SA3 declined in the amount of water delivered while SA1 and SA2 increased. Flood protection for the majority of the LEC did not vary much, however, portions of south Dade County were adversely affected.

Performance Measures and Indictors Used;

1. Regional Water Budgets
    - Simulated Average Annual Water Budget Summary for Water Conservation System
    - WCA-1
    - WCA-2A
    - WCA-2B
    - WCA-3A
    - WCA-3B
    - LEC Developed Area
2. LOSA
    - Stage Duration Curves and Stage Hydrographs for STA1E
    - Stage Duration Curves and Stage Hydrographs for STA1W
3. WCAs System

Average Annual Ground Water and Levee Seepage Flows from WCAs and ENP to LEC

4. WCAs: WCA-1, WCA-2B, WCA-3B
   Stage Duration Curves at South end of WCA-1
   Normalized Stage Duration Curves and Hydrograph at South end of WCA-2B
   Normalized Stage Duration Curves and Hydrograph at South end of WCA-3B
5. LECSA
   Number of Months of Simulated Water Supply Cutbacks
   Volume of Water Supply Cutbacks by Use Type
   Percentage of Simulated Water Supply Cutbacks by Use Type
   Mean Annual Regional System Water Supply Deliveries to LEC Service Areas
   Average Annual Ground Water and Levee Seepage Flows from from WCAs & ENP
   Average Annual Regional Water Supply Deliveries to LEC Service Area
   Number of days LECSA Water Supply Deliveries were made from L.O.
6. LECSA: NPBC, SA1, SA2, SA3
   All listed under Complete Listing of the Hydrologic Performance Measure Graphics dated 10/9/97 from web server
7. Bays:
   Mean Surface Flows Discharges to North, Central, and South Biscayne Bay
   Mean Surface Flows Discharged to Lake Worth Lagoon

Recommendations:

1. The Water Catchment Area needs to be connected to the regional system. There may be too much water being discharged to tide without much benefit or perhaps too much to the Loxahatchee. Future alternatives should take into account the need to store additional surface water discharges.

2. For SA2, perhaps more of Hollywood's demands could be moved west or perhaps decreased through conservation and greater utilization of reuse. Or additional water could be stored in the secondary canals in the C-11 Basin creating more head to move water east. Surface water levels could be increased up to the highest level that does not compromise flood protection. Or modify the operation of the water preserve area. A recharge canal could be constructed between the C-14 and C-13 to bring water to the North Lauderdale well field area. Another potential source for water may be the Acme Basin B. This water could be stored, treated and released to meet water supply needs.

3. In SA3 the seepage barrier could be compensated for by sending more water down L-31N, C-111, C-1, C-100, C-102 and C-103 in the dry season.

4. Modify regulation schedule or propose alternatives that will make more water available from Lake Okeechobee in order to meet demands and avoid shortage triggers. Perhaps ASR wells combined with a modified regulation schedule could be considered.

5. May need to modify seepage barriers and/or increase surface water flows to meet canal salt-water intrusion criteria and estuarine needs.

6. Increase surface water deliveries and/or hold water higher within the primary and secondary canals.

7. The operation of the C-111 and L-31 may need to be altered to enable flows in the dry season to meet water supply needs and reduce flows in the wet season for flood protection, or alter the seepage barrier.

Subteam Issues:

1. Additional Performance Measures Requested:

a. A breakdown of the number of times and duration of each water shortage in the LECSA would be helpful. This will enable analysis of a 1 in 10 level of certainty. The tentative goal for water supply is a frequency of no more than 3 events in the 31 year period of record for no longer than four months triggered by either Lake Okeechobee or local wells, for a maximum number of six events for each service area.

b. Stage duration and hydrographs and an interim salt-water intrusion criteria for S-21, S-20F, S 21A, S-123, S-33 and S-13A.

c. Stage duration curves and hydrographs for cells containing local trigger wells in the LECSA.

d. Stage duration curves and daily stage hydrographs for Dade County as follows:
(1) R12/C28 & R15/C25 to monitor flood protection;
(2) 3 cells near Northwest Well field, just west, east and south of well field,
(3) Cell containing the West Well field

2. Further Recommendations and Questions:

a. The bathtub may need to be modified to improve effectiveness and to protect the Pennsuco Wetlands. The bathtub should be modeled between the C-6 and C-9 canals. The quality of water pumped from the C-6 continues to be a concern; a soap dish may be necessary. Water could be held higher in the Dade-Broward Levee canal, perhaps in the wet season and in the dry season. Continue to keep the Dade-Broward Levee canal improvements with a depth of 12'. Add a structure on the Snapper Creek extension.

b. Concern has been expressed over the under reporting of the effects of the impoundment to the south. The model may need to be adjusted to reflect how it functions. Please specify any discharges/back pumping to the Everglades in future Alternatives.

c. Please address the increased reliance on reuse by utilities will in the model. Hollywood, Palm Beach and Dade have planed to increase their capacity for reuse. This includes the 150 mgd plant in Dade County that could discharge to the Northeast Shark River Slough. This potential component needs to be discussed by the AET and ADT

because of water demand concerns and also with Corps staff who are working with Miami-Dade Water and Sewer Department. In addition, conservation could be addressed in future alternatives more extensively to reduce demands and perhaps avoid shortages. The 1 in 10 level of certainty as required by HB 715 needs to be met by traditional water resources.

d. A low-tech set of components could be run to understand how the model would respond without additional highly managed components. This could be part of a sensitivity analysis.

e. Does the Loxahatchee National Wildlife Refuge (WCA-1) stop discharging to the coast when the stage drops below 14'? The regulation schedule indicator should be changed from the canal to the interior of the Refuge.

E. Northern / Central Everglades (WCAs, Holey Land, Rotenberger)

Holey Land and Rotenberger WMAs

Performance Based Comments:

Under the 2050 Base, Holey Land is approximately 0.4-0.6 ft too deep year round, with long periods of several years' inundation and interannual fluctuations that exceed those of the NSM. Neither Alternative 1 nor the Starting Point ameliorates these problems. Water depths in Rotenberger exceed NSM, but to a lesser degree than in Holey Land. Both Holey Land and Rotenberger are at risk of cattail expansion into ponded areas, and both areas have also experienced extensive soil loss through oxidation and muck fires. For this reason, it is important to avoid both prolonged high and low water conditions.

Performance Measures and Indicators Used:

1. Normalized Weekly Stage Hydrograph for Indicator Regions 28 and 29
2. Temporal Variation in Mean Weekly Stage for Indicator Regions 28 and 29
3. Inundation Pattern (1965-1995) for Indicator Regions 28 and 29
4. Normalized Stage Duration Curves for individual model cells in Holey Land and Rotenberger
5. Normalized Stage Hydrographs for individual model cells in Holey Land and Rotenberger
6. Long Term Mean Monthly Stage for Holey Land and Rotenberger

Recommendations:

1. Depths in Rotenberger should be reduced by approximately 0.3 ft year round.

2. Depths in Holey Land should be reduced by approximately 0.5 ft year round, while minimizing the frequency and duration of depths greater than 1.5 ft and less than -1.0 ft.

3. The new Holey Land regulation schedule proposed by the GFC may provide a way to achieve the desired hydropattern.

Loxahatchee National Wildlife Refuge (WCA-1)

Performance Based Comments:

In northern LNWR, the 2050 Base, Starting Point and Alternative 1 all have lower depths than the 1995 Base. Alternative 1 has a shorter hydroperiod than NSM, and its annual recession begins later than NSM, while depths exceed those of NSM throughout the year. In southern LNWR, Alternative 1 is approximately 2.0 ft deeper than NSM year-round.

Performance Measures and Indicators Used:

1. Normalized Weekly Stage Hydrograph for Indicator Regions 26 and 27
2. Temporal Variation in Mean Weekly Stage for Indicator Regions 26 and 27
3. Inundation Pattern (1965-1995) for Indicator Regions 26 and 27
4. Stage Duration Curves at gage cells STA 1E and South WCA-1
5. Normalized Stage Hydrographs at gage cells STA 1E and South WCA-1

Recommendations:

1. A rainfall based operational system should be evaluated for the entire WCA system, including LNWR, in a future alternative. Before doing this, however, there is a need to better define target conditions for LNWR. Therefore, the subteam recommended that the ADT identify, for use in a future alternative, the model components that would be needed to evaluate a system-wide rainfall-based operational plan.

2. Additionally, the ADT should try to identify components that could reduce the north-south depth differences, with the aim of including these in a future alternative.

WCA-2A

Performance Based Comments:

The 2050 Base, Alternative 1, and the Starting Point all are similar in performance; however, wet season highs are too deep in wet years in the south, while dry season lows are too low in the north. Year-to-year fluctuations and within-year depth reversals are larger than those of NSM. All three scenarios overshoot NSM depths during the wet season by as much as 0.5 ft and may further damage already-damaged tree islands. There is a concern that increased flows into northern WCA-2A, if implemented, might lead to higher phosphorus loadings. Alternative 1 and the Starting Point exhibit shortened hydroperiods during dry years in Northern WCA-2A (90% in Alternative 1; 88% in Starting Point; 94% in NSM).

Performance Measures and Indicators Used:

1. Normalized Weekly Stage Hydrograph for Indicator Regions 24 and 25
2. Temporal Variation in Mean Weekly Stage for Indicator Regions 24 and 25
3. Inundation Pattern (1965-1995) for Indicator Regions 24 and 25
4. Stage Duration Curves at gage 2-17.

Recommendations:

1. Alternative 2 should attempt to reduce the magnitude of water depth reversals and the amplitude of high/low fluctuations, to better approximate NSM depth patterns.

WCA-2B

Performance Based Comments:

Alternative 1 and Starting Point are still far too deep for too long. Neither alternative is acceptable as a hydropattern for a reasonably healthy Everglades marsh. Water of this depth has the potential to adversely affect snail kite foraging and nesting in WCA-2B. It is not clear that this point that there will be environmental benefits to seepage control in this area.

Performance Measures and Indicators Used:

1. Normalized Weekly Stage Hydrograph for Indicator Region 23
2. Temporal Variation in Mean Weekly Stage for Indicator Region 23
3. Inundation Pattern (1965-1995) for Indicator Region 23
4. Normalized Stage Duration Curve and at gage 2B-21

Recommendations:

1. Alternative 2 should attempt to bring depths down substantially. A reduction of about -1.5 ft relative to Alternative 1 is desirable. It would be desirable for the excess water to be moved into WCA 3A and conveyed south to ENP ,if possible.

WCA-3A

Performance Based Comments:

North of Alligator Alley, in northwestern WCA-3A west of the Miami Canal (Indicator Regions 20 and 22) there is little difference between Alternative 1, the Starting Point, and the 2050 Base. All three scenarios show substantial improvement over the 1995 Base, with improved hydroperiods and depths and reduced frequencies of drydowns. During extremely wet years, Alternative 1 exhibits the worst flooding in this area, and all three scenarios show flooding that is greater than NSM. In northeastern WCA-3A east of the Miami Canal (Indicator Region 21), the 2050 Base, Starting Point, and Alternative 1 are all about 0.4 ft deeper than NSM during the dry season. As with Holey Land and Rotenberger WMAs, there is a concern that increased depths, while beneficial in protecting soils from oxidation, may lead to cattail proliferation.

Overall, there is no dramatic evidence in this region of environmental benefits from EAA storage to the north.

South of Alligator Alley, east of the Miami Canal (Indicator Region 19), the water is too deep for too long. Alternative 1 has the greatest depths, which may be attributable to the plug in the L-67A canal (Component J) causing water to back up into this area. In central WCA-3A west of the Miami Canal (Indicator Region 17), Alternative 1, the Starting Point and 2050 Base have reduced depths and dry out more frequently than the 1995 Base. This is of concern because the area represents one of last unimpacted areas of the Everglades that exists outside of ENP.

In southern WCA-3A, Alternative 1, the Starting Point, and 2050 Base all show substantial benefits in reduced ponding relative to the 1995 Base. Alternative 1 appears to be slightly wetter than the Starting Point and 2050 Base at the 3A-4 and 3A-28 gage locations; however, Indicator Region 14 is overall slightly drier in Alternative 1 than in the other two simulations. In the far south of WCA-3A there will be a need to consider potential reductions in the prey base for snail kites owing to the increased frequency of dry-outs; this, however, needs to be evaluated at a regional scale. Alternative 1 continues to show ponding west of the L-67 levees; this occurs primarily along the northern reaches of the L-67s above the Component J plug.

Throughout WCA-3A, during the peak flood years of 1994-95, none of the scenarios prevented long-duration periods of flooding that were in excess of NSM predictions for the same years. Such historically "unnatural" floods could cause severe damage to tree islands, even if NSM-like conditions prevailed during most years.

Performance Measures and Indicators Used:

1. Normalized Weekly Stage Hydrograph for Indicator Regions 14 and 17-22
2. Temporal Variation in Mean Weekly Stage for Indicator Regions 14 and 17-22
3. Inundation Pattern (1965-1995) for Indicator Regions 14 and 17-22
4. Normalized Stage Duration Curves for gages 3A-2, 3A-NW, 3A-28, 3A-4, and 3A-3

Recommendations:

1. Future alternatives need to reduce the excessive ponding in east central WCA-3A (east of Miami Canal and south of Alligator Alley) and to convey the water south to ENP if possible.

2. It is important to avoid further drying in the relatively unimpacted central part of WCA-3A south, to the west of the Miami Canal.

3. Future alternatives need to consider ways to avoid excessive flooding during high-water years.

WCA-3B

Performance Based Comments:

In northwest WCA-3B, Alternative 1 has water that is too deep for too long, although water depths generally meet NSM in southeast WCA-3B (Indicator Region 16). The L-67A canal plug (Component J) does not appear to have reduced flows into WCA-3B; however it may be responsible for the increased ponding in the northwest. Overall, there appears to be plenty of water in WCA-3B, but it is not getting conveyed into ENP.

Performance Measures and Indicators Used:

1. Normalized Weekly Stage Hydrograph for Indicator Regions 15 and 16
2. Temporal Variation in Mean Weekly Stage for Indicator Regions 15 and 16
3. Inundation Pattern (1965-1995) for Indicator Regions 15 and 16
4. Normalized Stage Duration Curves for gages 3B-2 and 3B-SE

Recommendations:

1. Alternative 2 needs to improve conveyance of water from WCA-3B into ENP.

Pennsuco Wetlands

Performance Based Comments:

1. Alternative 1, like the Starting Point, tends to both overshoot and undershoot NSM hydroperiods. Generally, depths exceeded those of NSM.

Performance Measures and Indicators Used:

1. Normalized Stage Duration Curve for Pennsuco wetlands
2. Normalized Stage Hydrograph for Pennsuco wetlands
3. NSM Hydroperiod matches for Pennsuco wetlands

Recommendation:

1. There is a need to reduce water depths in Pennsuco and develop hydropatterns that are more similar to NSM.

Subteam Issues:

1. There is inconsistency in the use of rainfall-based operations in the 2050 Base. The current regulation schedule is used in LNWR, whereas rainfall-based operational rules are modeled for the remaining WCAs as well as Holey Land and Rotenberger WMAs.

2. The issue of the hydrologic target for LNWR needs further exploration. Should NSM or the current refuge regulation schedule be used? The subteam received a comment noting that the decreased depths that appear in the 2050 Base, Starting Point, and Alternative 1 may affect the

water supply function of WCA-1, and hence that there may be a need to supplement water in LNWR for future urban supply. This issue was tabled and will be brought up after input from the ADT on future components for LNWR.

3. It was noted that the water depths in WCA-2B for the 1995 Base seemed unrealistic. We need to consult actual gage data to determine whether or not the model output is providing good guidance as to general depth patterns.

F. Southern Everglades (Everglades National Park, Model Lands)

Northeast Shark Slough

Performance Based Comments:

Alternative 1 was similar to the Starting Point, except that the frequency of drydowns was greater. Neither alternative, nor the 1995 Base or the 2050 Base, approached NSM-like conditions. We expected to see an improvement over the Starting Point in this region, because increased conveyance capacity under L-29 and the Tamiami Trail, as well as elevation of the road bed were modeled in Alternative 1. Increased ponding depths and longer hydroperiods in the eastern areas of Everglades National Park are a critical component of ecological restoration for the Restudy. Current models are not delivering the necessary water to this region.

Performance Measures and Indicators Used:

1. Normalized Stage Duration Curve at NESRS-2 (R21, C24)
2. Average Monthly Overland Flow South of Tamiami Trail, East of L-67E
3. Average Annual Hydroperiod Differences
4. Ponding Depth Differences
5. Inundation Duration Figure and Table (# of Events), Region 11
6. Region 11 Stage hydrographs and stage duration curves
7. Gauge NESRS-1 and Gauge NESRS-2 stage hydrographs and duration curves

Recommendations:

1. The subteam recommends that Alternative 2 incorporate seepage control strategies, such as buffer lands and limited curtain walls where development has occurred directly adjacent to protected, natural areas.

2. Alternative 2 should improve connections between WCA-3A and WCA-3B by opening up larger areas along L-67A and L-67C, in order to increase overland flow to WCA-3B and the eastern areas of Everglades National Park.

Shark Slough

Performance Based Comments:

In a dry year NSM predicts a persistent pool aligned along the mainstem of the historic Shark Slough in accordance with natural topographic contours. The pattern of dry season pooling evident in Alternative 1 is similar to that seen today, with dry season ponding occurring in WCA-3 and with values lower than NSM south of the Tamiami Trail. The cessation of sufficient overland flow into Shark Slough has resulted in the reduction or elimination of persistent pooling, as well as increased frequency of drydowns, affecting survival and productivity of aquatic organisms. Alternative 1 consistently failed to meet NSM (hydroperiods and flows predicted by Alternative 1 were lower than NSM). In dry years, Alternative 1 indicated that Shark Slough dried for as much as three months longer than under NSM. This would be devastating to aquatic communities. Alternative 1 was generally worse than the Starting Point (shorter hydroperiods).

Performance Measures and Indicators Used:

1. Stage Duration Curve (NP-201) North Shark Slough
2. Stage Duration Curve (P-33)
3. Stage Duration Curve (G620)
4. Stage Duration Curve (NP-34)
5. Stage Duration Curve (NP-36)
6. Stage Duration Curve (NP-38)
7. Hydroperiod Differences
8. Inundation Duration Figures and Table (# of Events); Regions 9, 10, 12
9. Indicator Regions 7, 10, and 12, average annual hydroperiods and ponding depths
10. Indicator Region 10 ponding depths
11. Average Monthly Overland Flows South of Tamiami Trail, West of L-67 extension to ENP

Recommendations:

1. The ADT should explore using the lowest management intensive strategy to establish rainfall-based flows. These flows must extend from the upper to the lower reaches of the Everglades catchment area in sufficient volume to maintain dry season pool formations that persist within the downstream reaches of the system, with hydropatterns similar to those predicted by NSM.

Rocky Glades/Eastern Marl Prairies

Performance Based Comments:

Alternative 1 was similar to the Starting Point. Ponding depths were close to NSM, but hydroperiods for both alternatives and bases were shorter than NSM, especially in the more eastern areas.

Performance Measures and Indicators Used:

1. Marsh Stage Duration Curve (G-596)

2. Marsh Stage Duration Curve (G-1502)
3. Average Annual Hydroperiod Differences
4. Ponding Depth Differences
5. Inundation Duration Figure and Table (# of Events), Region 8
6. Indicator Regions 1, 8, average annual hydroperiods and ponding depths

Recommendations:

1. Ecological restoration will require longer continuous hydroperiods, greater ponding depths, and more frequent occurrence of multi-year continuous inundation.

Taylor Slough

Performance Based Comments:

The model outputs provided for Taylor Slough were not adequate for our analyses-we need output from additional gauges, which was requested at the AET meeting. Analysis of available output (NP-207) suggested that Alternative 1 did not differ significantly from Alternative 0 and that ponding depths and hydroperiods for both alternatives and bases were similar to NSM.

Performance Measures and Indicators Used:

1. Annual Average Hydroperiod Differences
2. Ponding Depth Differences
3. Stage Duration Curves (NP-207), (Cell R8 C29)
4. Inundation Duration Figure and Table (# of Events), Region 1
5. Indicator Region 1 average annual hydroperiods and ponding depths

C-111

Performance Based Comments:

Alternative 1 was similar to the Starting Point. Ponding depths for both alternatives and bases were similar to NSM, and hydroperiods were shorter in the northern part and shorter in the southern part of C-111 than NSM; the frequency of drydowns was greater than NSM. No effort has been made to model changes that would occur if fragmentation of this area by canals, etc. were reduced.

Performance Measures and Indicators Used:

1. Stage Duration Curve (G-1251)
2. Annual Average Hydroperiod Differences
3. Ponding Depth Differences
4. Inundation Duration Figure and Table (# of Events), Region 4

Recommendations:

1. Sheetflow must be reestablished in the C-111 Basin, including filling in canals, ditches, and culvert pools to reduce colonization opportunities by exotic organisms, and to eliminate artificially large, deep-water habitats that result in changes in species composition and energy flow in the adjacent wetlands.

Model Lands

Performance Based Comments:

Alternative 1 was similar to the Starting Point. Hydroperiods for both alternatives and bases were shorter than NSM, and the frequency of drydowns was greater. All water management alternatives, including Alternative 1, demonstrate that the Model Lands remain hydrologically isolated, producing conditions that do not approximate NSM conditions. The basin is closed and ecologically degraded, lacking connections with adjacent wetlands to the west. The significant reduction in spatial extent of the historic natural system requires that efforts be made to restore these wetlands.

Performance Measures and Indicators Used:

1. Stage Duration Curves (R8, C29)
2. Annual Average Hydroperiod Differences
3. Ponding Depth Differences
4. Inundation Duration Figures and Tables (# of Events), Regions 5, 6

Recommendations:

1. Explore strategies to improve the timing and distribution of water deliveries to the Model Lands.

Subteam Issues:

1. Technical Issues:

    a. Taylor Slough. The model outputs provided for Taylor Slough were not adequate for the analyses. Output from additional gauges is needed, which was requested at the AET meeting.

    b. The Southern Everglades subteam recommends that a comprehensive strategy for ecological restoration be developed and implemented in one of the next alternatives. The model needs to maximize what can be achieved for ecological restoration, possibly by suspending some rules for the modeling effort. The subteam recommends a plan that includes recommendations presented in earlier discussions, such as the 1984 memorandum that introduced the 7-Point Plan proposed by Everglades National Park. This model run would include the degradation of levees and filling of canals, establishment of a rainfall-driven

system, and the reestablishment of sheetflow. A general assessment of Alternative 1 indicated that a number of structures (e.g., curtain walls and new structures) have been added, but conversely, the beneficial activity of the removal of structure and canals was not evident. Alternative 1 did not appear to greatly advance the majority of hydrological restoration objectives promoted by the 7-Point Plan, and subsequent documents. The subteam recommends that future alternatives incorporate modifications to address these concerns. It is recommended that the multi-agency team of hydrologists and engineers also look for innovative solutions to hydrological and ecological restoration, because it is clear that current strategies are not doing enough for restoration of the Everglades.

G. Estuaries and Bays

Caloosahatchee Estuary

Performance Based Comments:

The results of the Alternative 1 model simulation indicate that the number of Lake Okeechobee regulatory releases increased as compared with the 2050 Base and Starting Point. As for the basin high and low flow violations, they decreased when compared with the 2050 Base, 1995 Base, and Starting Point, but they still have not reached the set targets.

Performance Measures and Indicators Used:

1. Number of times salinity envelope criteria were not met for the Caloosahatchee Estuary.
2. Number of times high discharge criteria (mean monthly flow > 2,800 and 4,500 cfs) were exceeded for the Caloosahatchee Estuary.
3. Stage Hydrograph at C-43

Recommendations:

1. The subteam recommends that a mean monthly baseflow of 300 cfs be provided through S-79 and that all regulatory releases from Lake Okeechobee be eliminated to meet the desirable salinity distributions in the Caloosahatchee Estuary. Preliminary studies performed by the SFWMD indicate the need for S-79 to contribute a minimum 300 cfs mean monthly baseflow to the Caloosahatchee Estuary.

2. The stage hydrograph in the C-43 basin indicates that there may be opportunities to capture more excess runoff within the basin if the reservoir could accommodate additional storage. The Lower West Coast Planning Division of the SFWMD could provide an operational rule for a storage facility in the C-43 basin. The operational rule was developed using the Optimization model and the period of record rainfall.

3. Continue moving toward meeting targets (number of violations) for low (<300cfs) and high (>2,800cfs) flows of 60 and 22 months, respectively.

St. Lucie Estuary

Performance Based Comments:

The desirable total freshwater inflows from the contributing watersheds are based upon estimates of salinity requirements of the oyster and shoal grass indicator species. Historical flows, along with the recovery time of certain species, were evaluated to estimate the natural flow variation that should be allowed to exceed these suggested limits. The number of violations acceptable is defined as the targets for the performance measures. The results of the Alternative 1 model simulation indicate that Lake Okeechobee releases were eliminated and there was a substantial decrease in the number of high and low basin flow violations as compared with the 2050 Base, 1995 Base, and Starting Point. In addition, all of the high flow violations contributed from Lake Okeechobee in previous simulations were eliminated.

Performance Measures and Indicators Used:

1. Number of times salinity envelope criteria were not met for the St. Lucie Estuary.
2. Number of times high discharge criteria (mean monthly flow > 1,600 & 2,500 cfs) were exceeded for St. Lucie Estuary.
3. Stage Hydrograph at C-44

Recommendations:

1. Continue moving toward meeting targets (number of violations) for low (<350cfs) and high (>1,600cfs) flows of 50 and 13 months, respectively. Increase storage capacity of reservoir in C-44 basin and capture additional runoff to reduce the number of times high flows exceed criteria and minimum flows are not met. Continue with no Lake Okeechobee regulatory releases.

Lake Worth Lagoon

Performance Based Comments:

The performance measure showed that Alternative 1 reduced flow to the Lake Worth Lagoon. However, the target of no regulatory releases has not been met. There is no significant difference between Alternative 1, the 2050 Base and the Starting Point in the average wet season flows.

Performance Measures and Indicators Used:

1. Wet/Dry Season Average Flows Discharged to Lake Worth through S40, S41, and S155 for the 31 year simulation.

Recommendations:

1. Based upon previous studies done on the Lake Worth Lagoon, a mean monthly freshwater baseflow of roughly 150 cfs is needed to maintain estuarine conditions in the dry season.

Biscayne Bay

Performance Based Comments:

The Starting Point reduces wet season flows to Biscayne Bay by > 40% and dry season flows by > 50%. Alternative 1 provides for slightly more freshwater input into southern and central Biscayne Bay and more to northern Biscayne Bay than the Starting Point. However, Alternative 1 still provides much less water than either 2050 Base or 1995 Base. In this regard, Alternative 1 has not moved Biscayne Bay toward the goal of more estuarine conditions.

Performance Measures and Indicators Used:

This section under development.

Recommendations:

1. Improve estuarine conditions by increasing water flow to Biscayne Bay.

Florida Bay

Performance Based Comments:

In comparison to the Starting Point, Alternative 1 increased the frequency of undesirable high-salinity events and decreased the frequency of desirable low-salinity events in all coastal basins of Florida Bay, as simulated by salinity/P33 stage regressions, and in the multiple-station average for Florida Bay, as simulated by the Florida Bay Ecosystem Model. Both Alternative1 and the Starting Point were improvements compared to the 2050 Base and 1995 Base. The Starting Point accomplished approximately half the progress that is required to accomplish the salinity objectives for the coastal basins, but Alternative1 was a step backwards.

P33 stages above 6.3 feet msl correspond to coastal basin salinities below the levels that indicate undesirable high salinity events for each basin. There are approximately 79 months of the period of record when NSM4.5 exceeds that stage, but Alternative 1 does not. These events occurred in January-May during 19 years, in June- October during 15 years, and in November-December during eight years of the 31-year period of record.

P33 stages above 7.3 feet msl correspond to coastal basin salinities below the levels that indicate desirable low salinity events for each basin. There are approximately 48 months of the period of record when NSM4.5 exceeds that stage, but Alternative 1 does not. These events occurred in January-February during two years, in July-October during 10 years, and in November-December during four years of the 31-year period of record.

The regression and correlation analyses that are used to provide the above estimates are documented under the web page section entitled “About the Performance Measures”. The following discussion is an addition to the documentation.

There are many issues involved in the ecological restoration of Florida Bay and its mangrove estuary. The development of conceptual models has been instrumental in identifying those issues. In all the ecosystems to be restored by the Restudy, including Florida Bay, performance measures concentrate on regional water management and associated water quality issues, with the realization that other management issues must being addressed in other forums. The restoration of a range of salinity variation, with more frequent low salinity events and less frequent high salinity events, has been identified by the scientists working in the Bay and mangrove estuary as an important concern for ecosystem restoration. The main issue that can be addressed by the Restudy is salinity, as affected by freshwater heads, flows, and water management practices upstream.

High salinity levels above which it is desirable to decrease the frequency of events, and low salinity levels below which it is desirable to increase the frequency of events, were identified for five coastal basins through the process of developing the conceptual models of Florida Bay and the mangrove estuary. The high and low salinity levels are based upon current knowledge and best professional judgement of scientists working in these systems concerning the biological responses of coastal basin flora and fauna to salinity.

The regression analyses indicate that salinity in the coastal basins of Florida Bay varies inversely with fresh water stages in the Everglades upstream of the coastal basins. Coastal basin salinity reflects general water conditions over a broad area of Everglades National Park, as evidenced by the correlation of salinity in the broad front of coastal basins, from Joe Bay to North River Mouth in Whitewater Bay, to stage at the P33 gage, which is located more than 16 miles upstream of the coast. The stage/salinity relationships also reflect general water conditions over time. Regression lines are nearly identical regardless of whether or not a one-month lag is used between stage and salinity. P33 stages that are calculated from the regressions for given coastal basin salinity levels differ by only 0.1 ft with or without the one-month lag.

The regression analyses provide a simple, broad-brush approach to estimate coastal basin salinity based on P33 stage, and to calculate P33 stage for given high and low salinity levels. There is a reasonably high correlation between stage and salinity that accounts for at least half the salinity variation in all five coastal basins. Regressions using the one-month lag between stage and salinity assure that mean monthly stages at P33 are entirely antecedent to the monthly salinity measurements in the basins, and for that reason lagged relationships are used in Run 2 of the Restudy. Correlation coefficients are lower for regressions using the one-month lag, compared to those not using the lag, for two of the five basins (Joe Bay and Garfield Bight). However, it is irrelevant if a one-month lag between stage and salinity is or is not used regarding salinity estimates and stage calculations.

The high and low salinity levels that are identified for each coastal basin by the conceptual models correspond to mean monthly P33 stages of at least 6.3 and 7.3 feet msl,

respectively, based on the stage/salinity regressions. However, natural variability in salinity is viewed as beneficial to the coastal basin ecosystems. The restoration target is to attain the 6.3 and 7.3 stages and corresponding salinity levels only when they would have occurred in response to rainfall under pre-drainage conditions. The Natural System Model (NSM) is used as the best estimate of the frequency and timing of these events as they would have occurred under pre-drainage conditions during the 31-year period of record. To summarize, the upper and lower salinity levels are based on biological responses to salinity, the corresponding P33 stages are based on the stage salinity regressions, and the frequency and timing of the stages are based on NSM. The salinity and stage targets were developed independently of NSM, and NSM is used only to estimate their frequency and timing.

Performance Measures and Indicators Used:

This section under development.

Recommendations:

1. In order to decrease the frequency that coastal basin salinity exceeds the upper levels identified for each basin, raise P33 stages above 6.3 ft MSL during approximately 79 months of the period of record when NSM 4.5 exceeds that stage but Alternative 1 does not. These events occurred in January-May during 19 years; in June-October during 15 years; and in November-December during 8 years of the 31 year period of record.

2. In order to increase the frequency that coastal basin salinity drops below the lower levels identified for each basin, raise P33 stages to 7.3 ft. MSL during approximately 48 months of the period of record when NSM 4.5 exceeds that stage but Alternative 1 does not. These events occurred in January-February during 2 years; in July-October during 10 years; and in November-December during 4 years of the 31 year period of record.

P33 STAGE 6.3 FT MSL

TIME EQUALLED OR EXCEEDED

NSM	70%
ALT1	50%
STRTPT	57%
50BASE	42%
95BASE	34%

APPROXIMATE PERIODS WHEN 6.3 WAS ATTAINED BY NSM, BUT NOT BY ALT 1

1965	JAN-FEB	OCT
1966	MAR	
1967	MAR	JUL
1968		

1969	MAR-JUN		
1970			
1971	JAN-FEB	SEP-OCT	NOV-DEC
1972		JUN	DEC
1973	JAN-FEB	SEP-OCT	DEC
1974		SEP	DEC
1975	JAN-MAR	AUG-OCT	
1976	JAN		
1977		SEP-OCT	NOV
1978	JAN-FEB	JUN-AUG	
1979	FEB-MAY	JUN-SEP	
1980	MAR-MAY	JUN-SEP	DEC
1981	JAN-MAR		
1982	FEB-MAR	JUN	
1983			
1984	MAR-MAY		
1985	FEB		
1986	APR		
1987		SEP	
1988	FEB		DEC
1989			
1990		AUG	NOV-DEC
1991	JAN-FEB		
1992	MAR-MAY		
1993			
1994		JUL	
1995			

P33 STAGE 7.3 FT MSL

TIME EQUALLED OR EXCEEDED

NSM	13%
ALT1	4%
STRTPT	7%
50BASE	1%
95BASE	1%

APPROXIMATE PERIODS WHEN 7.3 WAS ATTAINED BY NSM, BUT NOT BY ALT 1

1965		
1966	JUL-OCT	NOV-DEC
1967	OCT	
1968	JUL-AUG & OCT	NOV

1969		JUL-SEP	
1970	JAN-FEB	JUL-OCT	
1971			
1972			
1973			
1974			
1975			
1976			
1977			
1978			
1979			
1980	JAN		
1981		SEP-OCT	
1982			
1983		JUL-SEP	
1984			
1985			
1986			
1987			
1988			
1989			
1990			
1991		OCT	NOV-DEC
1992		JUL	
1993			NOV
1994		OCT	
1995			

H. Big Cypress Subregion

Performance Based Comments:

Relative to the 2050 Base, there were no hydroperiod benefits / impacts in the Big Cypress from either the Starting Point or Alternative 1 scenarios.

None of the three Base or two Alternative scenarios showed ponding depth differences compared to NSM conditions. The only exception might be along the southwest corner, which might be an effect of the Barron River Canal along Route 29 or more probably is an effect of being located along the model boundary. However, relative to the NSM, ponding depth differences in the lower portion of WCA-3A along the preserve that are present in the 1995 Base, do not exist in the 2050 Base or any of the Alternatives. This would suggest that L-28 does not affect water levels under scenarios other than the 1995 Base.

Relative to NSM, there are no real peak stage differences among the 2050 Base, Starting Point, and Alternative 1 scenarios that are important to the Big Cypress. What differences there are, are minor or probably model boundary effects.

Relative to the 2050 Base, there are no peak stage differences in the Big Cypress among the 2050 Base, Starting Point, or Alternative 1 scenarios. Alternative 1 makes the south end of WCA-3A slightly drier and its north end slightly wetter, which should produce better conditions adjacent to the Big Cypress and could reduce any effects L-28 may be having on Big Cypress water levels.

Relative to the 1995 Base, again there are no peak stage differences in the Big Cypress among the 2050 Base, Starting Point, and Alternative 1 scenarios. The most important change has to do with lowered water levels in the southeastern half of WCA-3A, which again reduces the influence of L-28 on Big Cypress water levels. This is primarily accomplished in the 2050 Base simulation, but there is some additional improvement in Alternative 1. There is a very small increase in peak stage in the southeastern portion of the Big Cypress in the 2050 Base and additionally in the Starting Point. This is largely a result of changes in flows to the Everglades.

With the exception of the two upland pines (Indicator Regions 32, 33) and west Slough (Indicator Region 13), for all of the preserve Indicator Regions, the non-NSM simulations were all similar to one another and water levels were lower than those in the NSM. They varied in being sometimes to consistently lower, and from slightly to much lower.

Those that were much lower were the two Indicator Regions 34 and 35 along the western boundary of the model. However, they, particularly Region 35, are probably much lower primarily because of problems with the NSM hydroperiods being much longer than they should be in the westernmost two (three?) columns of cells, given what we know about the current and historic plant communities in these areas.

The upland pine Indicator Regions 32 and 33 showed no real differences among the simulations.

The Robert Lake Strand Indicator Regions 40-44 south of Tamiami Trail showed little difference among the simulations. They all responded similarly.

The Indicator Regions along the eastern portion of the Big Cypress indicated differences between the NSM and the other simulations. These included the area from Mullet Slough (31, 38, 39) south through Raccoon Point (45) to the jetport area (36, 37). The Mullet Slough sites could be affected by upstream activities or possibly backwater effects of water management in the WCAs. Water levels as predicted by the NSM and other simulations for Mullet Slough Indicator Regions 38 and 39 were more similar during the period 1980-93 than before or after this period. Raccoon Point and the jetport could be affected by the management of the L-28 and adjacent WCA-3A.

The West Slough (Indicator Region 13) showed greater similarity between NSM and the 1995 Base than between either of them and the other simulations. The similarity between NSM and the 1995 Base tended to break down somewhat after 1985.

Performance Measures and Indicators Used:

1. Hydroperiod Distribution Maps
2. Hydroperiod Improvement Maps
3. Hydroperiod Differences Maps
4. Ponding Depth Maps
5. Ponding Depth Differences Maps
6. Peak Stage Differences Maps
7. Indicator Regions in or near Big Cypress (13, 31-45)
8. Normalized Weekly Stage Hydrographs
9. Temporal Variation in Mean Weekly Stage

Recommendations:

1. The effects of removing the L-28 levee would be interesting to see, based upon the effects observed on the Indicator Regions along the eastern portion of the preserve. Also, given system changes to be made in the 2050 Base, hydroperiods, ponding depths, and peak stages along the levee do not appear to be influenced by its presence after the 1995 Base.

2. In order to have more complete coverage of the Big Cypress that could assist with understanding the spatial distribution and thus maybe the causes of differences in the alternative simulations, the following four Indicator Regions should be added using the same performance measures as for the current Big Cypress Indicator Regions:
   R37-38, C5-6 (4 cells)
   R38, C10-11) (2 cells)
   R34-35,C6-7 (4 cells)
   R28-29, C4-5 (4 cells)

3. The following Indicator Regions could be collapsed into a single region:
   Indicator Regions 40-44 (R24, C8-11, and R25, C10);
   Indicator Regions 32-33 (R29-30, C8); identify as “Upland Pine”.

G. Water Quality

Performance Based Comments:

None at this time

Performance Measures Used:

1. Stage Duration and Stage Hydrographs for all reservoirs included in this alternative plan (Bird Drive, C-11 Caloosahatchee, St. Lucie, C-9, EAA, Indian Trail, Lake Belt, North Storage, Site 1)

2. Water Column Phosphorus Concentrations within the Everglades Protection Area (Everglades Water Quality Model)

3. Median Phosphorus and Chlorophyll a concentrations within Lake Okeechobee (Lake Okeechobee Water Quality Model)

Recommendations:

1. The Water Quality Team continues to recommend that a portion of the storage reservoir area proposed for north of Lake Okeechobee be located in the Taylor Creek/Nubbins Slough basin to reduce phosphorus loading into Lake Okeechobee. The Water Quality Team will recommend optimal size for this facility for preliminary planning purposes.

2. The storage reservoirs, particularly the above-ground storage reservoirs, should be operated to optimally capture phosphorus contained in inflows (and remove phosphorus from outflows). To the extent that phosphorus is a surrogate for other pollutants, optimal operation of these facilities for phosphorus removal will contribute to additional downstream pollution load reductions. The Team's present recommendation for optimal operation is to maintain at least 2.0-ft. depth in the reservoirs, with a minimum hydraulic retention time of 14 days.

3. Restudy components must meet State and Tribal water quality standards, as appropriate. In particular, increased flows to the Everglades Protection Area (EPA) over that which is in the "without project condition," (i.e. Everglades Forever Act fully implemented) must meet the yet-to-be-established numeric phosphorus criteria for the EPA (default concentration = 10 parts per billion). The preferred technology for achieving this standard has not yet been determined. Component design should continue to take into account current and future land uses in the vicinity of the components to assure that construction and operation of water quality treatment facilities necessary to meet water quality standards is not precluded.

Subteam Issues:

1. The Everglades Water Quality Model (EWQM) is not yet adjusted sufficiently to link to the Restudy website and adequately simulate future water column phosphorus concentrations; however, it is reliable for comparing relative concentrations associated with various hydrologic scenarios. It is hoped that the EWQM will be adjusted and synchronized to Restudy model runs after the December 10th posting of Alternative No. 2.

2. Due to in-lake phosphorus load and cycling processes, it is not expected that the Lake Okeechobee Water Quality Model (LOWQM) outputs will show significant differences between various hydrologic scenarios over the period of record.

3. The Team is still developing water quality performance measures. New performance measures recommended for further development at the AET meeting include: cumulative mass phosphorus loading into Lake Okeechobee, out of Lake Okeechobee, and into the EPA, and the relationship between extreme hydrologic events at Lake Okeechobee and water quality parameters.

Ecological / Water Quality Evaluations

ATLSS/Threatened and Endangered/Keystone Species

Performance Based Comments:

ATLSS outputs currently available are limited to Breeding Potential Indices (BPIs) for the Cape Sable Seaside Sparrow, white-tailed deer, and wading birds, based on hydrologic factors, and the fish model. Higher level analyses of ATLSS, such as individual-based simulations, are not yet available. Current ATLSS graphs and tables compare the 1995 Base to the 2050 future without project condition (Base), compare the alternative to the 2050 Base, but do not compare the alternative to the 1995 Base. The Corps is working to include the latter comparison in future analyses. The deer BPI demonstrated Alternative 1 counteracting the effect of the 2050 Base, in which case it is important to include comparison to the 1995 Base. The subteam calculated this on its own, and is summarized under B.3. below.

Disclaimers: The BPIs may allow a comparison of alternatives in the sense that hydrologic conditions are being changed in a favorable or unfavorable direction, but by themselves do not provide a measure of threat to the species or the degree of potential restoration/recovery. By the AET's definition, none of the ATLSS outputs could be called performance measures, because they cannot be related to a restoration target. These are being called "indicators". An added caution for the deer and wading bird BPIs: they are not designed to relate directly to the Florida panther or the wood stork.

A. Cape Sable Seaside Sparrow

1. 2050 v. 1995
The "core" (a.k.a. Old Ingraham Highway) CSS subpopulation remains unaffected, but the eastern and western (west of Shark Slough) subpopulations have generally a higher BPI in 1995 than in 2050.

2. Alternative 1 v. 2050
There is little difference between Alternative 1 and 2050, but 2050 is slightly more suitable for breeding than Alternative 1. The effects show up in different areas, depending on rainfall patterns and water delivery differences among years, but in general, the western subpopulation appears most sensitive to year-to-year changes.

B. White-tailed deer

1. 2050 v. 1995
There is a slight increase in BPI for 2050 relative to 1995, due to slightly drier conditions north of Tamiami Trail and slightly wetter conditions elsewhere.

2. Alternative 1 v. 2050
All scenarios show relatively poor breeding conditions in the WCAs, Loxahatchee NWR, and the northern end of Shark Slough. Alternative 1 slightly lowers the breeding potential even more in those areas. Areas of higher elevation and higher BPI (Long Pine Key, peripheral short hydroperiod marshes, and portions of BCNP) are not affected.

3. Alternative 1 v. 1995
Alternative 1 generally counteracts the effect of the 2050 Base, returning conditions close to the 1995 conditions. There is a minor decline in BPI in Rotenberger/Holey Land relative to 1995, but relation to climatological cycles could not be discerned.

C. Wading Birds

1. 2050 v. 1995
There was a slight improvement in BPI caused by features incorporated in the 2050 Base, because 2050 scenario produces slightly drier conditions north of Tamiami Trail and slightly wetter conditions elsewhere.

2. Alternative 1 v. 2050
Overall there was a slight improvement in BPI for Alternative 1 over 2050, particularly in peripheral marshes. The exceptions are WCA-3A and WCA-3B, where Alternative 1 is worse (in some cells equivalent to) than the 2050 Base condition.

D. Fish Model

Because this report arrived later, it was unable to be adequately reviewed. A cursory review indicates that both the 2050 Base and Alternative 1 are more productive overall for fishes. The areas predicted to have increased fish production correspond roughly with the areas predicted to have improved foraging conditions for wading birds. The subteam hopes to provide a more detailed summary of the affected areas in the review of Alternative 2.

Performance Measures and Indicators Used:

1. Breeding Potential Indices for the Cape Sable seaside sparrow, white-tailed deer, and generalized wading bird guild.

2. Fish productivity model.

Recommendations

1. The only potential concern at this time in development of alternatives appears to be the predicted breeding suitability for the Cape Sable seaside sparrow. Because the 2050 Base moves a greater proportion of flow to the eastern portion of the Tamiami Trail cross-section, it is not certain why the 2050 Base appears to be less favorable for breeding than the 1995 Base. A specific remedy cannot be offered until it is determined more precisely the timing and frequency of hydrologic events causing this. The subteam has suggested that Sonny Bass consult with Jane Comiskey at the University of Tennessee and that he work with hydrologists at ENP to tease out effects on the western subpopulation of the sparrow. Once it is determined the spatial and temporal patterns of flooding leading to this result, the ADT may be able to devise a remedy.

Subteam Issues

1. John Ogden has recommended changes to the wading bird model. His recommendation regarding a change in designation of most suitable water depths for foraging appears to be an easy modification of the model, if it is determined to be necessary. Other criticisms may not be as easily resolved, such as his request for the model to factor hydrologic conditions over the several antecedent years. The fish model does track populations of fish over several years. Could the fish model and wading bird BPI be interrelated over the next few months, in keeping with the long-term goal of ATLSS to link trophic levels?

2. The subteam needs assistance from ENP hydrologists and U. Tennessee to better define hydrologic patterns reducing the Cape Sable seaside sparrow BPI west of Shark Slough.

3. Can the white-tailed deer BPI be combined with existing panther radiotelemetry data to get a rough index of the proportion of the panther's prey base that predicted to be affected by the alternatives? The subteam suspects this will prove to be a small portion of the panther's prey base, but it would be a useful calculation if it can be done before May.

4. Rob Bennetts reports he is working with Don DeAngelis et al. to devise an interim snail kite indicator. There are no details at this writing, but it will be pursued.

5. The subteam recommends that development of an indicator for the crocodile be a high priority, and we intend to discuss this mainly with Frank Mazzotti. This indicator most likely would tie to the salinity predictions for the mangrove zone developed by Steve Davis.

Emerging Issues

Nothing to report at this time.

Cumulative Evaluations

Nothing to report at this time.

11-Nov-97

Hydroperiod Improvement New STRPT and ALTERNATIVE 1 Relative to Future Base

	Total Acres	% STRPT	Acres (1000's) worse	No change	improve	over	% Alt 1	Acres (1000's) worse	No change	improve	over
WCAs	842,240	4.6	51,200	683,520	38,400	69,120	10.3	94,720	563,200	87,040	97,280
LOX	145,920	0.0	-	133,120	-	12,800	0.0	2,560	130,560	-	12,800
2A	104,960	0.0	2,560	92,160	-	10,240	0.0	-	102,400	-	2,560
2B	28,160	0.0	2,560	2,560	-	23,040	54.5	-	7,680	15,360	5,120
3AN	204,800	2.5	10,240	189,440	5,120	-	18.7	33,280	117,760	38,400	15,360
3AS	289,280	0.0	23,040	258,560	-	7,680	1.8	48,640	194,560	5,120	40,960
3B	69,120	48.1	12,800	7,680	33,280	15,360	40.7	11,024	10,240	28,160	20,480
ROT	33,280	0.0	-	33,280	-	-	0.0	-	33,280	-	-
HOL	35,840	0.0	-	35,840	-	-	0.0	-	35,840	-	-
PEN	10,240	75.0	-	-	7,680	2,560	75.0	-	-	7,680	2,560
ENP	486,400	64.7	10,240	140,800	314,880	20,480	55.3	7,680	194,560	268,800	15,316
Ever	######	25.1	61,440	867,840	340,480	87,040	25.8	102,400	796,160	350,720	107,520
SRS		94.9	-	-	143,360	7,680	88.1	-	17,920	133,120	-

Notes: In WCA3B, improvement in STRPT is 2:1 in the 30-90d category, Alt 1 improvements 5:4 in the 7-30d
In Pennsuco, improvements in STRPT = 7-30 day category, in the Alt 1 improvements are in the 30-90d category
In Pennsuco, overshoots NSM in STRPT <=30d category vs Alt 1 where overshoots are in the >30d category.

	STRPT	Alt 1
Acres w/Improved Hydroperiods =	**340,480**	**350,720**
Acres w/Shortened Hydroperiods =	**61,440**	**102,400**
Acres Too Wet =	**87,040**	**107,520**

11-Nov-97

REGIONAL PERFORMANCE MEASURES

% Hydroperiod Matches with NSM

Alternative 1

	Acres	% 1995	% 2050	% Old STRPT	% STRPT	% Alt 1	% Alt 1 > 95	% Alt 1 > 2050	% Alt 1 > Strpt
WCAs	842,240	67	75	76	76	76	9	1	0
LOX	145,920	81	77	75	79	79	-2	2	0
2A	104,960	83	76	85	76	76	-7	0	0
2B	28,160	55	55	73	91	73	18	18	-18
3AN	204,800	41	70	66	70	73	31	3	3
3AS	289,280	77	87	79	81	81	4	-6	-1
3B	69,120	48	37	85	56	59	11	22	4
ROT	33,280	8	69	85	69	69	62	0	0
HOL	35,840	50	64	36	64	64	14	0	0
PEN	10,240	25	25	25	25	25	0	0	0
ENP	486,400	52	62	73	85	78	26	16	-6
Ever	1,356,800	59	68	74	78	76	17	7	-2

13-Nov-97

Regional Performance Measure:
Ponding Depths
% cells matching NSM

	Total Acres	1995(%)	2050(%)	STRPT(%)	ALT 1(%)	% Alt 1 > 1995	% Alt 1 > 2050	% Alt 1 > STRPT
WCAs	842,240	55	73	72	68	13	-5	-4
LOX	145,920	47	58	56	56	9	-2	0
2A	104,960	88	76	76	76	-12	0	0
2B	28,160	36	18	0	9	-27	-9	9
3AN	204,800	69	85	86	81	12	-4	-5
3AS	289,280	35	79	79	72	37	-7	-7
3B	69,120	70	59	59	48	-22	-11	-11
ROT	33,280	46	85	85	85	38	0	0
HOL	35,840	71	64	64	64	-7	0	0
PEN	10,240	50	50	50	75	25	25	25
ENP	486,400	77	82	100	98	21	17	-2
Ever	1,356,800	62	75	81	78	16	3	-3